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ENVIRONMENT

Mr. Keith M. Krawczyk
Project Coordinator
MDEQ-RRD-Superfund
Constitution Hall – 3rd Floor South
525 West Allegan Street
Lansing, Michigan 48909-7926

Subject:
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
King Highway Landfill Operable Unit 3
Sampling Plan for the Stressed Vegetation Area

Date:
April 27, 2012

Contact:
Patrick McGuire

Phone:
315.671.9233

Email:
pat.mcguire@arcadis-us.com

Our ref:
B0064583.0003.00675

Dear Mr. Krawczyk:

On behalf of Georgia-Pacific LLC (Georgia-Pacific), ARCADIS has prepared this *Sampling Plan for the Stressed Vegetation Area* (Sampling Plan) to address the area of stressed vegetation on the north side of the King Highway Landfill (KHL) of the King Highway Landfill Operable Unit 3 (KHL OU) located in Kalamazoo, Michigan.

In an e-mail dated February 27, 2012, the Michigan Department of Environmental Quality (MDEQ) notified Georgia-Pacific of an area of stressed vegetation on the north side of the KHL, immediately south of the diversion berm (e-mail included as Attachment 1). Figure 1 shows the approximate 270 square foot area of stressed vegetation on the north side of the landfill located approximately 180 feet south of the truck turnaround. During a subsequent conference call held on March 8, 2012 between representatives of MDEQ, the United States Environmental Protection Agency (USEPA), and Georgia-Pacific, it was agreed that a sampling plan for this area would be developed to evaluate if methane gas may be the potential cause for the stressed vegetation in this area of the KHL.

To assess the cause of the stressed vegetation on the north side of the KHL, this Sampling Plan will include a review of the final cover system sampling of the stressed vegetation area (e.g., thickness, soil gas characteristics, nutrient content). Additionally, this Sampling Plan proposes the collection of a soil sample to quantify the iron concentration in the drainage/barrier protection layer. This soil sampling is associated with sampling at the discharge of pore water outfalls as described in the *Sampling Plan for Pore Water Collection System Outfalls* (ARCADIS 2012). Finally, the Sampling Plan describes the schedule of activities, reporting of results, and potential corrective actions.

1. Review of Final Cover System Components

The MDEQ requested in the February 27, 2012 e-mail (Attachment 1), that subsurface features be reviewed; however, as-built drawings of the subsurface features of the KHL are not available for review. Alternatively, the existing as-built drawing of the KHL surface features installed within the final cover system in the area of stressed vegetation (Attachment 2) was reviewed to identify any features that may be impacting the vegetation (i.e., gas vents, monitoring wells, a depression that would pool water). The as-built drawing for the KHL does not show any surface features in this area that would cause the vegetation to become stressed and damaged.

However, this does not eliminate the possibility that localized settlement has occurred over time and a depression now exists. During upcoming field activities, described below, the stressed vegetation area will be inspected for indications of a change in contour suggesting a depression exists. Additionally, during sampling activities described in the *Sampling Plan for Pore Water Collection System Outfalls* (ARCADIS 2012), that will take place during a rainfall event, the stressed vegetation area will be inspected for signs of pooling water.

2. Stressed Vegetation Area Sampling

The objective of the gas sampling activities is to determine if soil gas components may be the cause of the stressed vegetation. One possible cause for the stressed vegetation may be landfill gases migrating through the final cover system in the area of stressed vegetation. Landfill gas that migrates through soil can kill the root system, resulting in visible vegetative stress within the area of migration (USEPA 2005). Landfill gas present in the soil atmosphere tends to make the soil anaerobic by displacing the oxygen, thereby asphyxiating the roots of the plants. Generally, the higher the concentration of methane and/or carbon dioxide and the lower the amount of oxygen, the greater the extent of damage to vegetation (USEPA 1993). Plant roots generally function best at oxygen levels above 10 percent (Kozlowski 1985). As oxygen drops below 5 percent of atmospheric content, root growth and the root's ability to generate elongation force (force generated by the root to elongate through soil pores) precipitously declines (Souty & Stepniewski 1988). Thus, where methane and carbon dioxide levels are displacing oxygen concentrations in the soil air to less than 5 percent by volume, it can be reasonably assumed that the stressed vegetation area may be caused by the migration of landfill gas through the final cover system.

To evaluate whether landfill gas is causing damage to the vegetation, Georgia-Pacific proposed the installation of a temporary borehole to determine the composition and concentrations of landfill gas in this area. The temporary borehole

will be located at the approximate center of the 270 square foot stressed vegetation area, as shown in the detail on Figure 1. Consistent with the Draft Final Operation and Maintenance Plan (ARCADIS 2012), a ¾-inch diameter borehole approximately 1 to 1½ feet deep will be installed using a slide hammer. Landfill gas will be monitored by a Landtec GEM-500™ or GEM-2000™ portable gas analyzer by inserting the tube attached to the gas analyzer into the borehole to a depth approximately one to two inches above the bottom of the borehole. The borehole will then be covered. After approximately 30 to 45 seconds, the percent, by volume, for methane, carbon dioxide, oxygen and balance gas (nitrogen) in air will be measured and recorded.

The depth of the vegetative layer will be measured in the same general location of the temporary borehole to assess the thickness of the topsoil in the stressed vegetation area. If the thickness of the soil in the area of stressed vegetation is less than 6 inches (the design thickness of the vegetative layer), additional topsoil may need to be added to the area to provide sufficient soil thickness for plant growth. Additionally, a grab sample will also be collected from the vegetative layer and analyzed for pH, and organic and macronutrient content (i.e., percent total organic content, and phosphorus, nitrogen, and potassium). The pH, and organic and macronutrient content of the soil will be evaluated to determine if fertilizer needs to be added to this area to provide sufficient conditions for plant growth. The vegetative layer sample will be sent to KAR Laboratories, Inc. (KAR), located at 4425 Manchester Road in Kalamazoo, Michigan, for analysis of pH, and organic and macronutrient content.

Soil Sample Collection

While field technicians are onsite collecting landfill gas concentrations from the area of stressed vegetation, a soil sample will also be collected from the drainage/barrier protection layer of the final cover system. Georgia-Pacific is proposing to collect a soil sample in the area near the stressed vegetation, as shown on Figure 1. The soil sample will be analyzed for iron concentrations to determine whether elevated iron concentrations in the soil are contributing to the orange-red stains at the pore water outfalls.

To collect the sample, a hand shovel will be used to remove the vegetation and topsoil layer in the sampling area, and a grab sample of the underlying sand fill within the drainage/barrier protection layer will be collected. The sample will be sent to KAR for analysis of iron.

All sampling activities will be carried out in accordance with the *Multi-Area Quality Assurance Project Plan for the Allied Paper, Inc./Portage Creek/Kalamazoo River*

Superfund Site (Multi-Area QAPP; ARCADIS 2010), the *Multi-Area Field Sampling Plan for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site* (Multi-Area FSP) and relevant addenda (ARCADIS BBL 2007a), and the *Multi-Area Health and Safety Plan for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site* (Multi-Area HSP) and relevant addenda (ARCADIS BBL 2007b).

3. Schedule and Reporting

Upon MDEQ approval of this Sampling Plan, ARCADIS and Georgia-Pacific will schedule the field activities to coincide with the next quarterly landfill gas monitoring event. Measured gas concentration data will be analyzed to identify whether stressed vegetation is caused by methane leakage. In addition, the analytical data received from the laboratory will be validated prior to evaluating the data. As stated above, the validated analytical data associated with the vegetative layer will be evaluated to determine whether the pH, and organic and macronutrient content of the soil is affecting plant growth. The validated analytical data associated with the drainage/barrier protection layer will be evaluated to determine whether high iron concentrations in the soil within the final cover system might be causing the orange-red stains at the pore water outfalls.

The validated laboratory analytical data for the vegetative and drainage/barrier protection layer soils, the landfill gas concentrations in the stressed vegetation area, and a summary letter presenting the results of sampling activities will be submitted to MDEQ and USEPA within 60 days after receiving the laboratory data. The letter will also indicate whether additional investigation activities are deemed necessary.

4. Corrective Actions

The following are potential corrective actions to be implemented based on sampling results.

- If methane is detected at elevated concentrations in the soil gas, then Georgia-Pacific will propose additional actions to investigate causes.

- If pH, organic content, or macronutrient levels are determined to be affecting vegetative growth, then the soil will be appropriately adjusted with fertilizer and area reseeded.

- If the soil thickness is less than 6 inches, then topsoil will be added to the area and the area reseeded.

In addition, the depressed area of ponding water immediately south of the truck turnaround on the north side of the KHL will also be backfilled with topsoil, graded, and seeded to facilitate vegetative growth and eliminate the ponding of water.

If you have any questions, please do not hesitate to contact me.

Sincerely,

ARCADIS

Patrick McGuire
Principal Environmental Engineer

Copies:
Daria Devantier, MDEQ
Judith Alfano, MDEQ
Michael Berkoff, USEPA Region 5
Garry Griffith, P.E., Georgia-Pacific
Dawn Penniman, P.E., ARCADIS

Attachments:
Figure 1: Site Plan and Proposed Sampling Locations
Attachment 1: February 27, 2012 E-mail from MDEQ to Georgia-Pacific Regarding the Stressed Vegetation Area
Attachment 2: Atwell-Hicks, Inc. Topographic Survey of the KHL

References

ARCADIS. 2012. Sampling Plan for Pore Water Collection System Outfalls. March 2012.

ARCADIS. 2012. Draft Final – *Operation and Maintenance Plan.* King Highway Landfill Operable Unit 3. January 2012.

ARCADIS. 2010. *Multi-Area Quality Assurance Project Plan for the Allied Paper, Inc./Portage* Creek/Kalamazoo River Superfund Site, Revision 1. March 2010.

ARCADIS BBL. 2007a. *Multi-Area Field Sampling Plan for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site, Revision 1.* October 2007.

ARCADIS BBL. 2007b. *Multi-Area Health and Safety Plan for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site.* May 2007.

Kozlowski, T.T. 1985. *Soil aeration, flooding and tree growth.* Journal of Arboriculture 11:85-96.

Souty N., Stepniewski W. 1988. *The influence of external oxygen concentration on axial root growth force in maize radicles.* Agronomie 8, 295–300.

USEPA. 1993. Solid Waste Disposal Facility Criteria – Technical Manual. EPA/530/R-93/017. November 1993. http://www.epa.gov/osw/nonhaz/municipal/landfill/techman/intro.pdf

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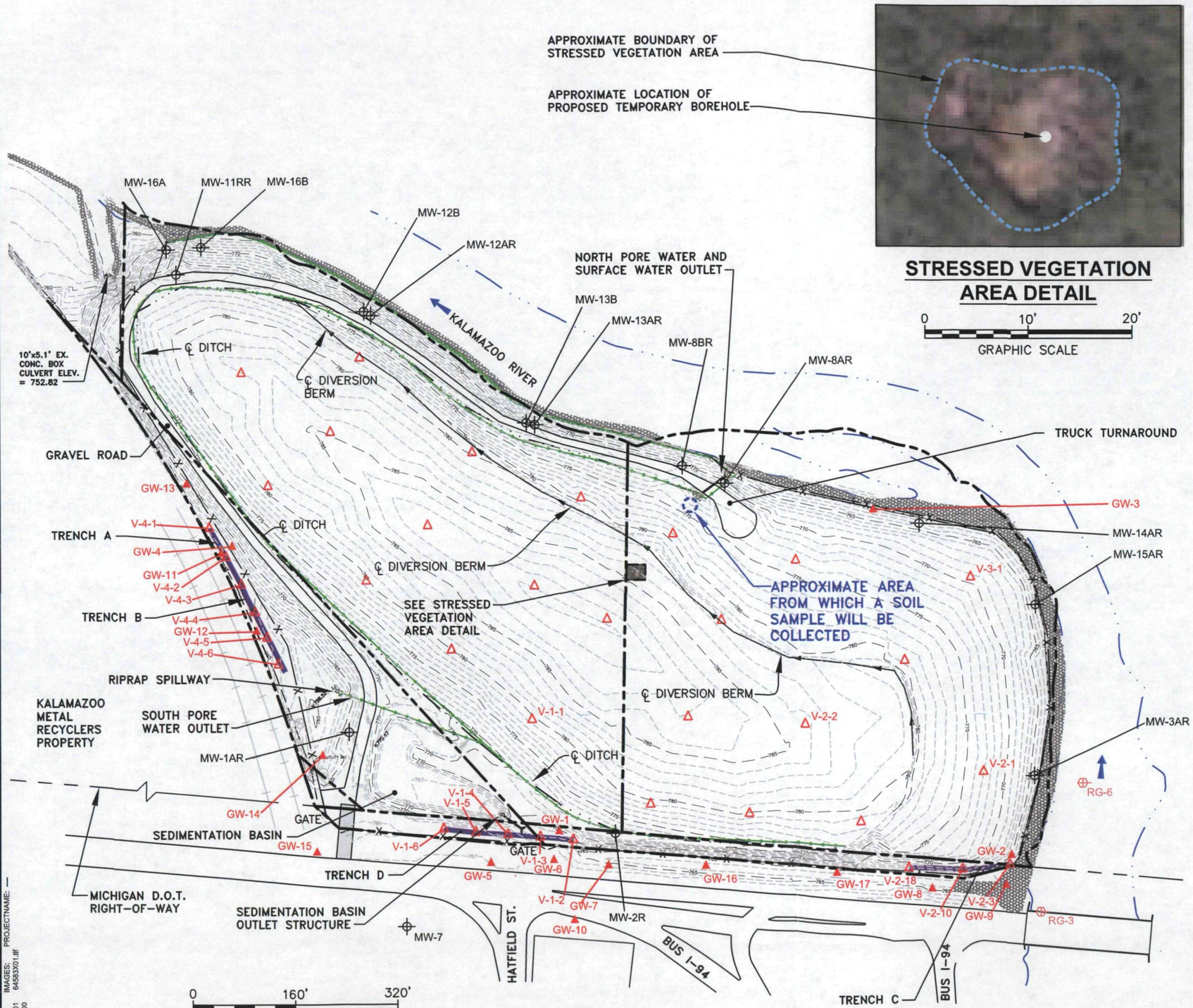
Figure 1

Site Plan and Proposed Sampling Locations



LEGEND:

- APPROXIMATE PROPERTY LINE
- DITCH LINE
- ABANDONED RAILROAD
- SHEETPILE WALL
- ACCESS ROAD
- RIPRAP
- CULVERT PIPE
- 768 FINAL AS-BUILT INDEX CONTOUR
- FINAL AS-BUILT INTERMEDIATE CONTOUR
- X SECURITY FENCE
- PORE WATER COLLECTION PIPE
- PORE WATER DRAIN
- APPROXIMATE WATER EDGE
- △ GAS VENTS (ORIGINAL 23; ONLY FOUR WERE GIVEN IDs)
- V-1-2△ CUTOFF TRENCH GAS VENTS
- LANDFILL GAS CUTOFF TRENCH
- FLOW DIRECTION
- MW-14 MONITORING WELL
- RG-3 RIVER GAUGE STATION
- GW-2 ▲ LOCATION OF GAS MONITORING PROBES

NOTES:

1. BASE MAP INFORMATION OBTAINED FROM CADD DRAWING FILE DEVELOPED BY RMT, INC., ANN ARBOR, MICHIGAN (CADD FILE: L1630SU01.DWG AS-BUILT SURVEY; 8/21/00).
2. FINAL AS-BUILT CONTOUR ELEVATIONS ARE SHOWN AND ARE BASED ON A FIELD SURVEY BY ATWELL-HICKS, INC., DATED 9/27/00 WITH REVISIONS DATED 10/23/00, 12/21/01, 12/10/02, AND 7/24/03.
3. ELEVATIONS ARE BASED ON NGVD OF 1929 (MSL).
4. PROPERTY SURVEY PERFORMED BY WILKINS & WHEATON ENGINEERING CO., INC., ON 7/1/96.
5. TOPOGRAPHIC CONTOUR INTERVAL IS 1 FOOT.
6. LOCATIONS OF GW-5, GW-6, GW-7, GW-8, GW-9, AND GW-10 ARE BASED ON A FIELD SURVEY BY TERRA CONTRACTING LLC, DATED 9/23/05.
7. LOCATION OF GW-11 IS BASED ON A FIELD SURVEY BY TERRA CONTRACTING LLC, DATED 1/11/06.
8. LOCATIONS OF RG-6, V-4-4, V-4-5, AND V-4-6 ARE BASED ON A FIELD SURVEY BY TERRA CONTRACTING LLC, DATED 6/7/06.
9. LOCATIONS OF V-1-2 THROUGH V-1-6, V-2-3, V-2-10, AND V-2-18 ARE BASED ON MULTIPLE FIELD SURVEYS CONDUCTED BY TERRA CONTRACTING, LLC. IN APRIL 2008. GAS VENTS V-2-4 THROUGH V-2-9, AND V-2-11 THROUGH V-2-17 ARE NOT SHOWN FOR CLARITY PURPOSES (THESE VENTS ARE LOCATED ALONG TRENCH C).
10. LOCATION OF GW-12 IS APPROXIMATE.
11. LOCATIONS OF GW-13 THROUGH GW-17 BASED ON FIELD SURVEY CONDUCTED BY PREIN & NEWHOF ON 11/1/11.

ALLIED PAPER, INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE

SAMPLING PLAN FOR STRESSED VEGETATION AREA

SITE PLAN AND PROPOSED SAMPLING LOCATIONS

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FIGURE 1

DRAFT

CITY: SYRACUSE DIV/GROUP: ENV/CAD DB: G. STOWELL L. POSENAUER L: FORAKER LD: PIC:D. COWIN PM: D. PENNIMAN TM: D. PENNIMAN LYR: ON=*; OFF=*REF*
G:\ENVCAD\SYRACUSE\ACTIB\006458300\03\00675\VEGETATION\64583G02.DWG LAYOUT: 1 SAVED: 4/23/2012 3:02 PM ACADVER: 18.1S (LMS TECH) PAGESETUP: C:\LB-PDF PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 4/23/2012 3:02 PM BY: FORAKER, LYDIA
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64583X00

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Attachments

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Attachment 1

February 27, 2012 E-mail from
MDEQ to Georgia-Pacific Regarding
the Stressed Vegetation Area

Sidari, Alexis

From: Krawczyk, Keith (DEQ) [KRAWCZYKK@michigan.gov]
Sent: Monday, February 27, 2012 9:23 AM
To: Sidari, Alexis; Penniman, Dawn; Griffith, Garry T.
Cc: Devantier, Daria W. (DEQ)
Attachments: Stressed Area.pdf

Categories: Communication Log E-mail

Good morning,

Check out some aerial images from Google Earth and Bing. Looks like one from 2004 and another from 2006 (assumed year) had no spot. One from 2010 kind of appears to have the spot, and then the 2011 aerial clearly shows the area.

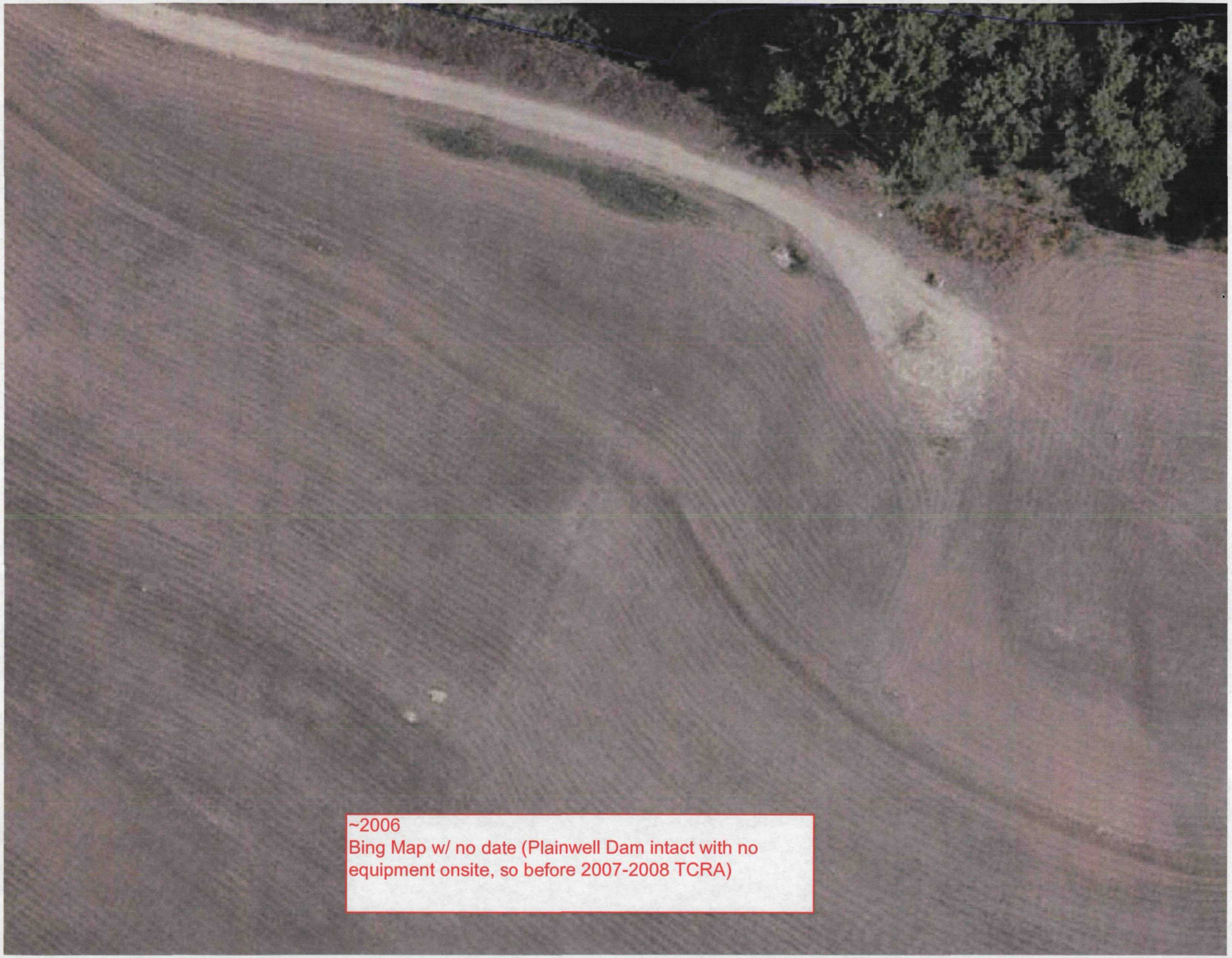
The KHL OU-3 spot that now has dead vegetation and some subsiding is just south of the berm, and is shown best on the last attached slide (#4). I think this has happened in the past year. Again, I do think it is worth looking at by a landfill engineer and propose you provide such a person with landfill experience, and I want to bring one of our landfill people. There is also an extremely large area of "iron bacteria" in the area of the north pore water discharge ...not saying they are related, but both items should be inspected. Can we set up an on-site meeting to get this looked at, when there is no snow cover? Before the meeting, I recommend a review of subsurface structures present within the landfill to consider possible reasons for the dead vegetation and subsiding, and having whatever schematics you have on hand for review, if needed. There appears to be a linear component of some sort running north-south through the area of dead vegetation that may or may not be related.

Also, please provide copies of the past four years of landfill site inspections by the end of this week. This is something that should have been recognized during site inspections, if it was present then, and maybe that will help us determine when this occurred. We have a few inches of snow on the ground now and it is supposed to snow more during the week. We do not want these issues remedied or modified in any way until we can have our engineer observe this, and we can agree on a plan to evaluate this further, if needed. However, it may be prudent to have the ability to collect gas samples from the stressed area and soil samples may be appropriate as well, along with characterization samples of the sand used for the drainage layer (to evaluate what might be mobilizing the iron and iron content), and water samples collected from the outlet.

With the current weather forecast and also wanting a day to look at the site inspection reports you provide, it seems like late next week might be an opportunity to conduct the visit. I will check on the availability of our Landfill person.

Keith M. Krawczyk
Senior Environmental Quality Analyst
Remediation Division
Michigan Department of Environmental Quality
krawczykk@michigan.gov
517-335-4103

10/12/2004
Google Earth



~2006
Bing Map w/ no date (Plainwell Dam intact with no equipment onsite, so before 2007-2008 TCRA)

4/4/2010
Google Earth

10/4/2011
Google Earth

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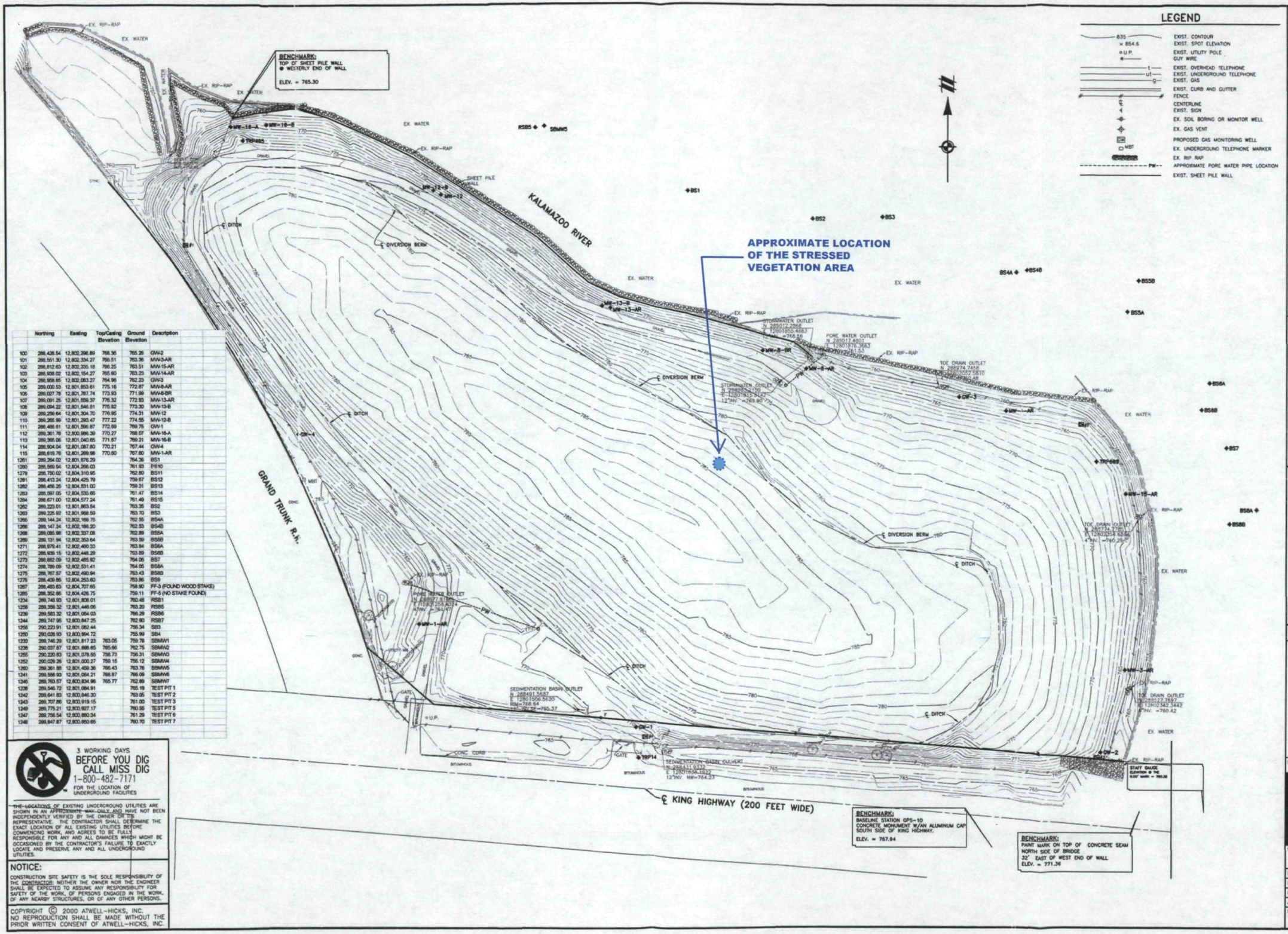
Attachment 2

Atwell-Hicks, Inc. Topographic Survey of the KHL



	Northing	Easting	Top/Casing Elevation	Ground Elevation	Description
100	288,426.54	12,802,296.89	768.36	765.26	GW-2
101	288,561.30	12,802,334.27	766.51	763.36	MW-3-AR
102	288,812.63	12,802,335.18	766.25	763.51	MW-15-AR
103	288,938.02	12,802,154.27	765.60	763.23	MW-14-AR
104	288,958.85	12,802,083.27	764.96	762.23	GW-3
105	289,000.53	12,801,853.81	775.16	772.87	MW-8-AR
106	289,027.78	12,801,787.74	773.93	771.99	MW-8-BR
107	289,091.25	12,801,598.37	776.32	772.93	MW-13-AR
108	289,094.22	12,801,546.51	775.82	773.30	MW-13-B
109	289,259.64	12,801,304.70	776.95	774.31	MW-12
110	289,265.99	12,801,293.47	777.22	774.55	MW-12-B
111	288,468.61	12,801,596.67	772.69	769.76	GW-1
112	289,361.78	12,800,986.39	770.27	768.07	MW-16-A
113	289,365.06	12,801,040.65	771.67	769.31	MW-16-B
114	288,904.04	12,801,087.80	770.21	767.44	GW-4
115	288,619.76	12,801,269.98	770.60	767.60	MW-1-AR
1261	289,264.02	12,801,676.29		764.36	BS1
1280	288,569.94	12,804,266.03		761.93	BS10
1279	288,750.02	12,804,310.95		762.80	BS11
1281	288,413.24	12,804,425.79		759.67	BS12
1282	288,456.25	12,804,531.00		759.31	BS13
1283	288,597.05	12,804,535.66		761.47	BS14
1284	288,671.00	12,804,577.24		761.46	BS15
1262	289,223.01	12,801,863.54		763.25	BS2
1263	289,225.92	12,801,968.59		763.70	BS3
1266	289,144.24	12,802,169.75		762.55	BS4A
1268	289,147.24	12,802,186.20		762.53	BS4B
1269	289,085.98	12,802,337.08		762.89	BS5A
1269	289,131.94	12,802,353.64		763.59	BS5B
1271	288,979.41	12,802,460.33		763.84	BS6A
1272	288,939.15	12,802,448.29		763.89	BS6B
1273	288,882.09	12,802,485.82		764.06	BS7
1274	288,789.09	12,802,531.41		764.05	BS8A
1275	288,767.57	12,802,490.94		763.43	BS8B
1276	288,408.86	12,804,253.60		763.86	BS9
1287	288,483.63	12,804,707.65		758.90	FF-3 (FOUND WOOD STAKE)
1285	288,352.66	12,804,426.75		759.11	FF-5 (NO STAKE FOUND)
1234	289,748.93	12,801,808.01		760.48	RSB1
1258	289,598.32	12,801,448.06		763.20	RSB5
1239	289,583.32	12,801,064.03		765.29	RSB6
1244	289,747.95	12,800,847.25		762.90	RSB7
1256	290,223.91	12,801,052.44		756.34	SB3
1250	290,028.93	12,800,994.72		755.99	SB4
1233	289,748.29	12,801,817.23	763.05	759.78	SBMW1
1236	290,037.67	12,801,898.65	765.96	762.75	SBMW2
1255	290,220.83	12,801,078.55	756.73	756.31	SBMW3
1252	290,029.26	12,801,000.27	759.15	756.12	SBMW4
1260	289,361.88	12,801,459.36	766.43	763.76	SBMW5
1241	289,568.93	12,801,064.21	768.87	766.09	SBMW6
1245	289,763.57	12,800,834.96	765.77	762.89	SBMW7
1238	289,546.72	12,801,084.91		765.19	TEST PIT 1
1242	289,641.83	12,800,846.30		763.05	TEST PIT 2
1243	289,707.86	12,800,919.15		761.00	TEST PIT 3
1249	289,775.21	12,800,927.17		760.95	TEST PIT 5
1247	289,756.54	12,800,880.34		761.29	TEST PIT 6
1248	289,847.87	12,800,850.65		760.70	TEST PIT 7

3 WORKING DAYS
BEFORE YOU DIG
CALL MISS DIG
1-800-482-7171
FOR THE LOCATION OF UNDERGROUND FACILITIES

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR ITS REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NOTICE:

CONSTRUCTION SITE SAFETY IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR; NEITHER THE OWNER NOR THE ENGINEER SHALL BE EXPECTED TO ASSUME ANY RESPONSIBILITY FOR SAFETY OF THE WORK, OF PERSONS ENGAGED IN THE WORK, OF ANY NEARBY STRUCTURES, OR OF ANY OTHER PERSONS.

ATWELL-HICKS, INC.
Civil Engineering • Surveying
Planning • Environmental Services
Ann Arbor, MI 734 994 4000
Brighton, MI 810 225 6000
Washington Twp., MI 810 786 9800

SECTION 23
TOWN 2 SOUTH, RANGE 11 WEST
KALAMAZOO TOWNSHIP
KALAMAZOO COUNTY, MICHIGAN

CLIENT
RMT, INC.
KING HIGHWAY SITE
TOPOGRAPHIC SURVEY
LAYER 1

CAD FILE
LV1630SU01

07-24-03 CHANGE SCL BOUNDS AND WELL LOCATIONS (MCB)
12-10-02 ADD SOIL BORING AND WELL LOCATIONS (BHM)
12-21-01 ADD BM (BJL)
10/23/00 PER CLIENT (MCB)
REVISIONS

DATE
SEPTEMBER 27, 2000

SCALE 0 30 60
1" = 60 FEET
DR. MCB CH. GLM
P.M. TDS
BOOK 70 (LV) p. 22
JOB LV01630.01
FILE NO.
LV-1231-22-1-1